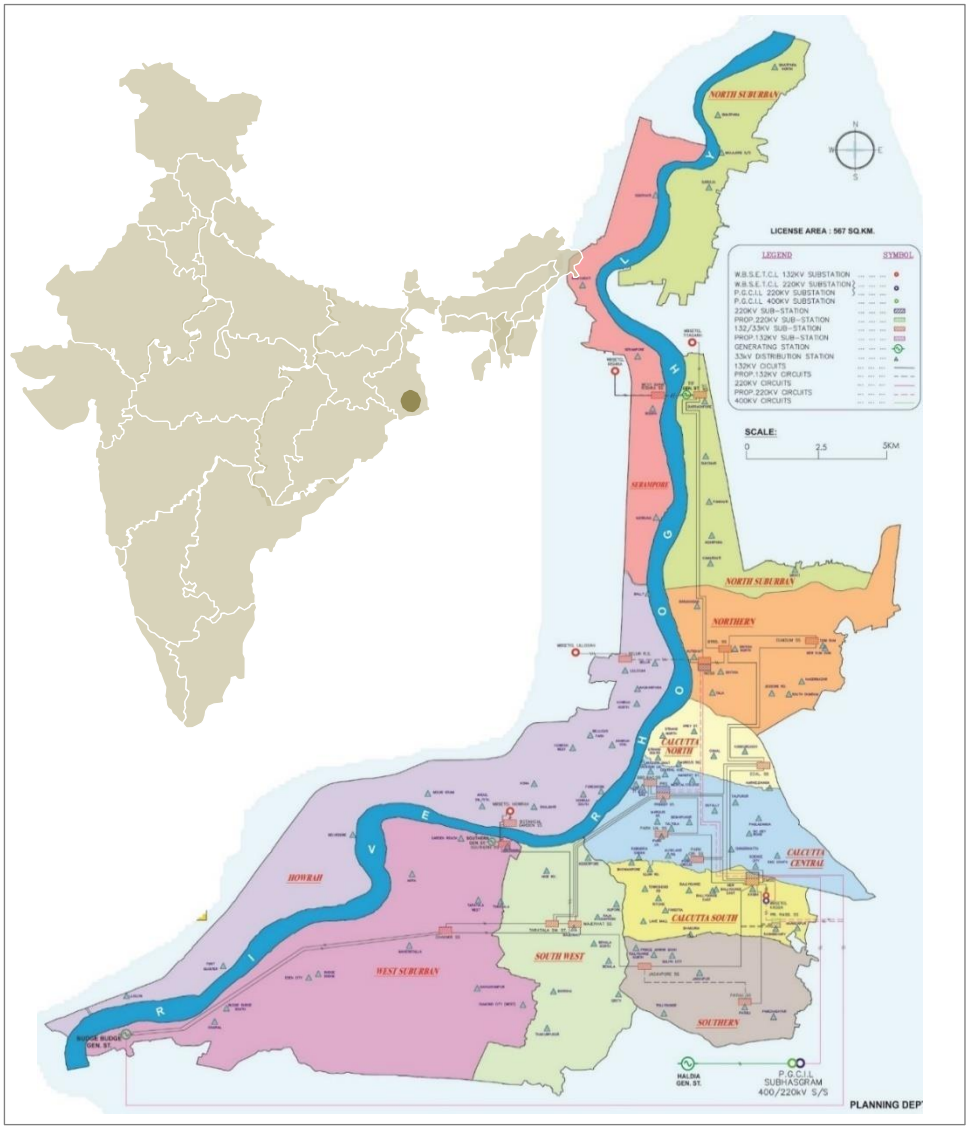
POWER QUALITY – ISSUES AND MITIGATION

29TH November, 2017

RP - Sanjiv Goenka Group
Growing Legacies

CESC LIMITED

POWER DISTRIBUTION IN AND AROUND KOLKATA SINCE 1899



KEY HIGLIGHTS

- Licensed area : 567 sq. KM
- Energy Sold : 9410 MU
  Peak Met: 2159 MW
- Generation Capacity:1125MW
- Consumers : ~31 lacs
- Dist. Franchisee: Kota, Bikaner & Bharatpur

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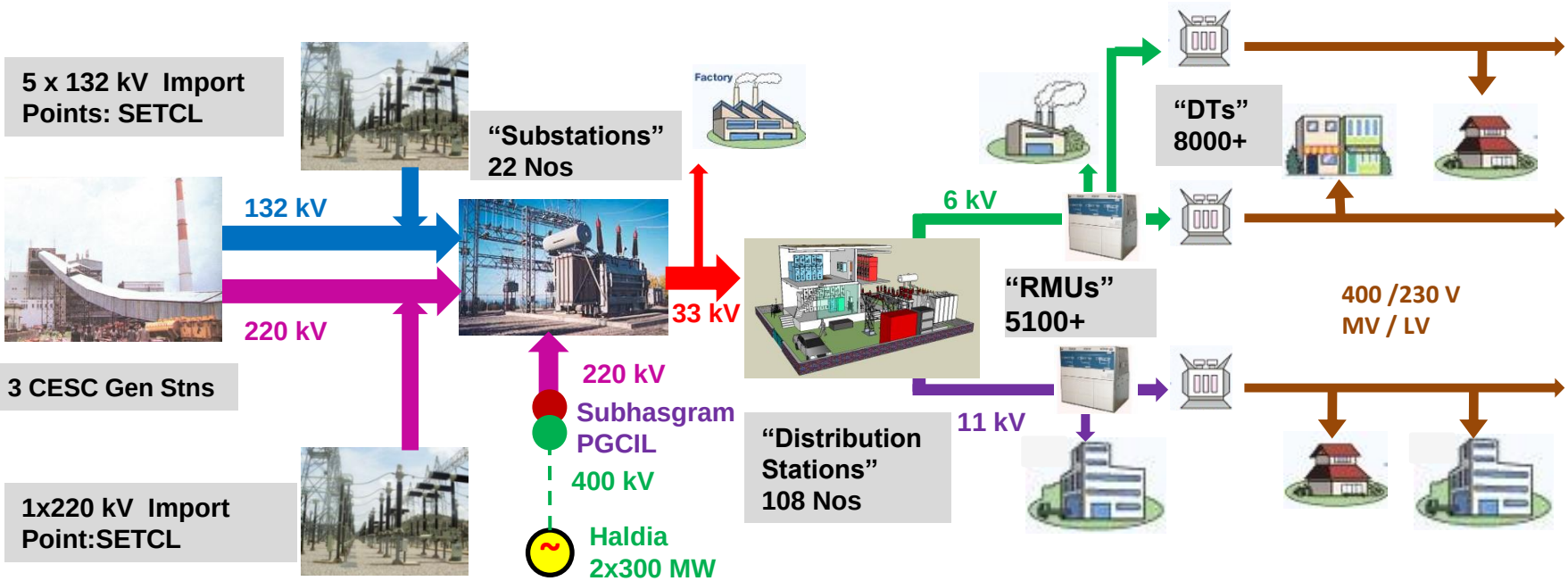
NETWORK ARCHITECTURE

CESC LIMITED



Operational Technologies

SCADA	EMS	DMS	OMS	DCS

Power Quality – Issues

Issues	Mitigation Measures
Voltage excursion beyond permissible limits at all Voltage Levels	220, 132, 33 KV – All Power Transformers (220-132/33 KV and 132/33 KV) are provided with On-load Tap Changer with Remote Control facility 11 , 6 KV – All Power Transformers (33/11-6 KV) are provided with On-load Tap Changer with AVR 230 / 400 V – All Distribution Transformers (11-6 / 0.415 KV) provided with off-load Tap Control switch. Capacitor Banks are provided on 132 , 33 , 11, 6 KV Voltage Levels. Automatic Power Factor Controllers provided on secondary side of Distribution Transformers. During Winter lean periods, embedded generators are used to absorb Reactive Power thereby controlling Voltage rise. Monitoring of DT Voltages through in-house developed Web Portal to identify real –time voltage excursions at LV side of DTs Analytics to identify disproportionate loading of DTs

Power Quality – Issues

Issues	Mitigation Measures
Frequency Excursion beyond permissible limits	Islanding from Grid in case of frequency excursions beyond limits. Embedded generation stabilises frequency of supply to the consumers.
Low Power Factor Conditions	Power Factor correction capacitors installed at different voltage levels.
Unbalanced Loads in LV network and neutral loading	In-house developed monitoring dashboard enables monitoring of phase imbalances in DTs. Corrective actions taken for balancing loads in 3 phases.
Voltage dips due to faults in the network	Instantaneous unit protection used in all EHT and HT circuits upto Distribution Stations. Fault clearing time < 100 msecs. Faults in Distribution Station 6/11 KV outgoing feeders : < 300 msecs. Transformer neutrals solidly earthed at 132 KV and 415 V systems. 33 KV System non-effectively earthed through earthing transformer. Transformer neutral Earthing < 1.0 ohm at 415 V; < 0.5 ohms at 132, 33 KV; <0.2 ohms at 220 KV and Generating Stations

Power Quality – Issues

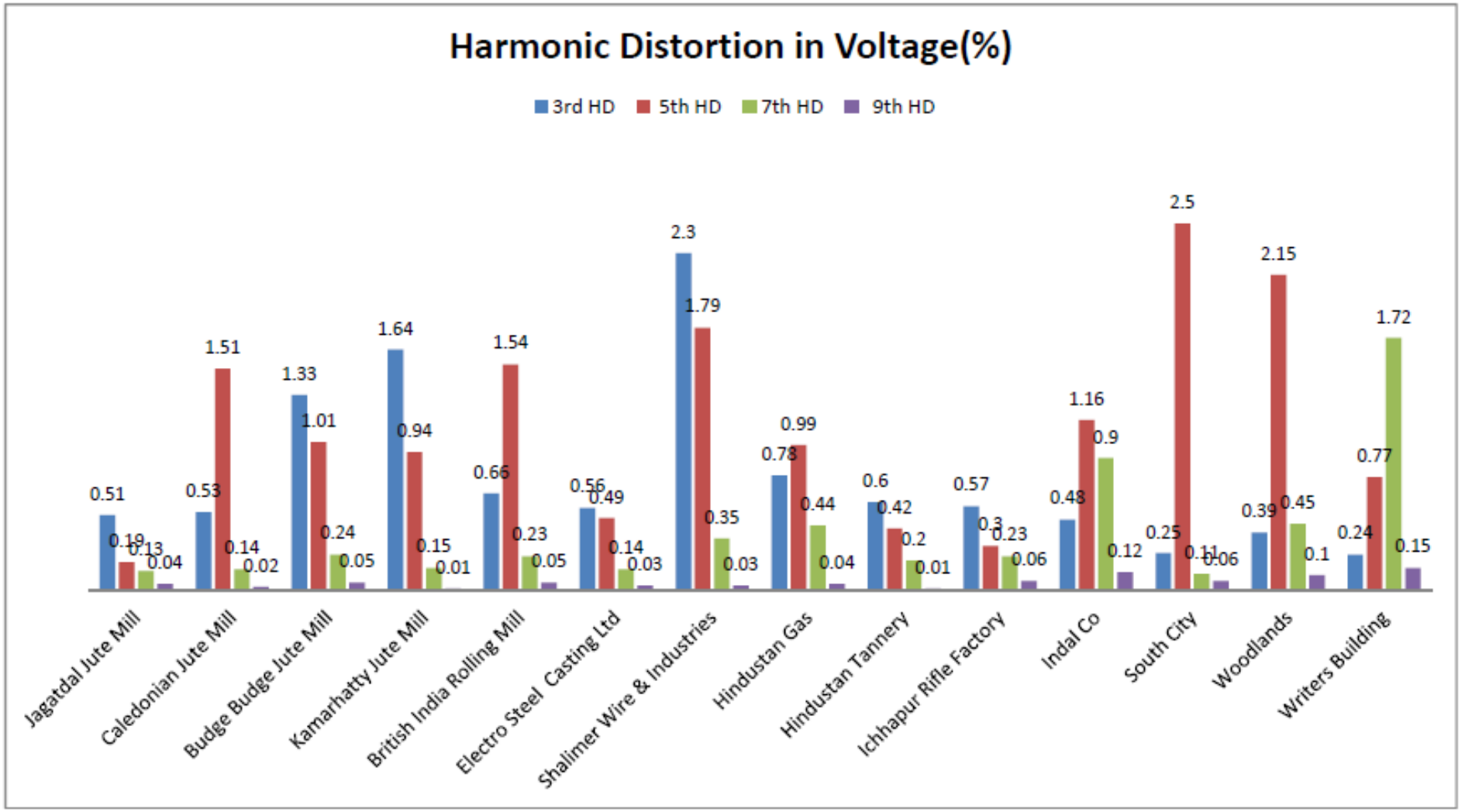
Issues	Mitigation Measures
Voltage and Current Harmonics at different levels	Measurements are done periodically for Voltage and Current Harmonics. Voltage % THD < 3% , Current % THD < 10 %.

POWER QUALITY ANALYSIS

Category	HT Industrial											HT Commercial	HT Domestic		CEA Limits
	Jute Mill				Steel & Rolling		Engineering & Workshop	Chemical	Tannery	Ordinance factory	Aluminium Factory	Shopping Mall	Hospital	Office	
Specific Consumer	Jagatdal Jute Mill	Caledonian Jute Mill	Budge Budge Jute Mill	Kamarhatty Jute Mill	British India Rolling Mill	Electro Steel Casting Ltd	Shalimer Wire & Industries	Hindustan Gas	Hindustan Tannery	Ichhapur Rifle Factory	Indal Co	South City	Woodlands	Writers Building	
Supply Voltage	3.3 KV	20 KV	6KV	6 .6 KV	6.6 KV	33 KV	6.6 KV	6 KV	6.6 KV	33 KV	6.6 KV	11 KV	6.6 KV	6.6 KV	
VOLTAGE DETAILS															
A. THD-R%	0.59	1.63	1.71	1.91	1.7	0.8	2.94	1.34	0.82	0.75	1.92	2.52	2.28	1.97	For 33 to 132 KV Voltage level, 1. THD is 5% and Individual Harmonic of any Particular Frequency is 3% 2. Maximum Permissible value of Voltage Unbalance is 3%
3rd HD	0.51	0.53	1.33	1.64	0.66	0.56	2.3	0.78	0.6	0.57	0.48	0.25	0.39	0.24	
5th HD	0.19	1.51	1.01	0.94	1.54	0.49	1.79	0.99	0.42	0.3	1.16	2.5	2.15	0.77	
7th HD	0.13	0.14	0.24	0.15	0.23	0.14	0.35	0.44	0.2	0.23	0.9	0.11	0.45	1.72	
9th HD	0.04	0.02	0.05	0.01	0.05	0.03	0.03	0.04	0.01	0.06	0.12	0.06	0.1	0.15	
B. Voltage Unbalance (%)	0.66	0.58	0.24	0.19	0.55	0.28	0.25	0.07	1.98	0.33	(-)	0.44	1.9	0.5	
C. Crest Factor	1.42	1.39	1.42	1.44	1.43	1.41	1.46	1.43	1.41	1.43	1.42	1.44	1.43	1.43	
CURRENT DETAILS															
A. THD-R%	1.52	8.15	2.88	3.27	3.95	6.97	7.88	1.74	2.36	6.19	7.27	5.91	12.71	5.47	
3rd HD	1.37	1.53	0	0.99	2.63	1.72	2.67	0.78	1.27	3.1	2.23	1.46	4.49	1.69	
5th HD	0.34	8.1	2.69	1.98	0	6.89	5.33	0.39	1.27	0	4.47	5.83	5.69	3.39	
7th HD	0.68	1	0.76	1.98	0	0.86	4	1.56	0	3.1	4.47	0.97	2.69	0	
9th HD	0	0	0	0.49	0	0	1.33	0	0	0	0	0	0.9	0	
B. Current Unbalance (%)	1.74	(-)	(-)	1.87	4.4	1.04	3.9	(-)	4	3.5	(-)	4.1	6.2	0.9	
C. Crest Factor	1.43	1.43	1.43	1.48	1.43	1.42	1.5	1.44	1.42	1.44	1.53	1.47	1.46	1.47	
D. Form factor	1.01	1.17	1.03	1.05	1.25	1.14	1.29	1.02	1.11	1.43	1.26	1.09	1.34	1.25	
OTHERS															
DPF	0.97	0.76	1	0.97	0.86	0.99	0.96	0.98	0.99	0.99	0.83	0.99	0.99	0.81	
VAR of 1 phase	48 lag	127 lag	1 lead	26 lag	10 lag	12 lag	12 lag	5 lead	10.05	2 lead	80 lag	16	34	20	

Power Quality – Issues

HT Consumer



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Power Quality – Issues

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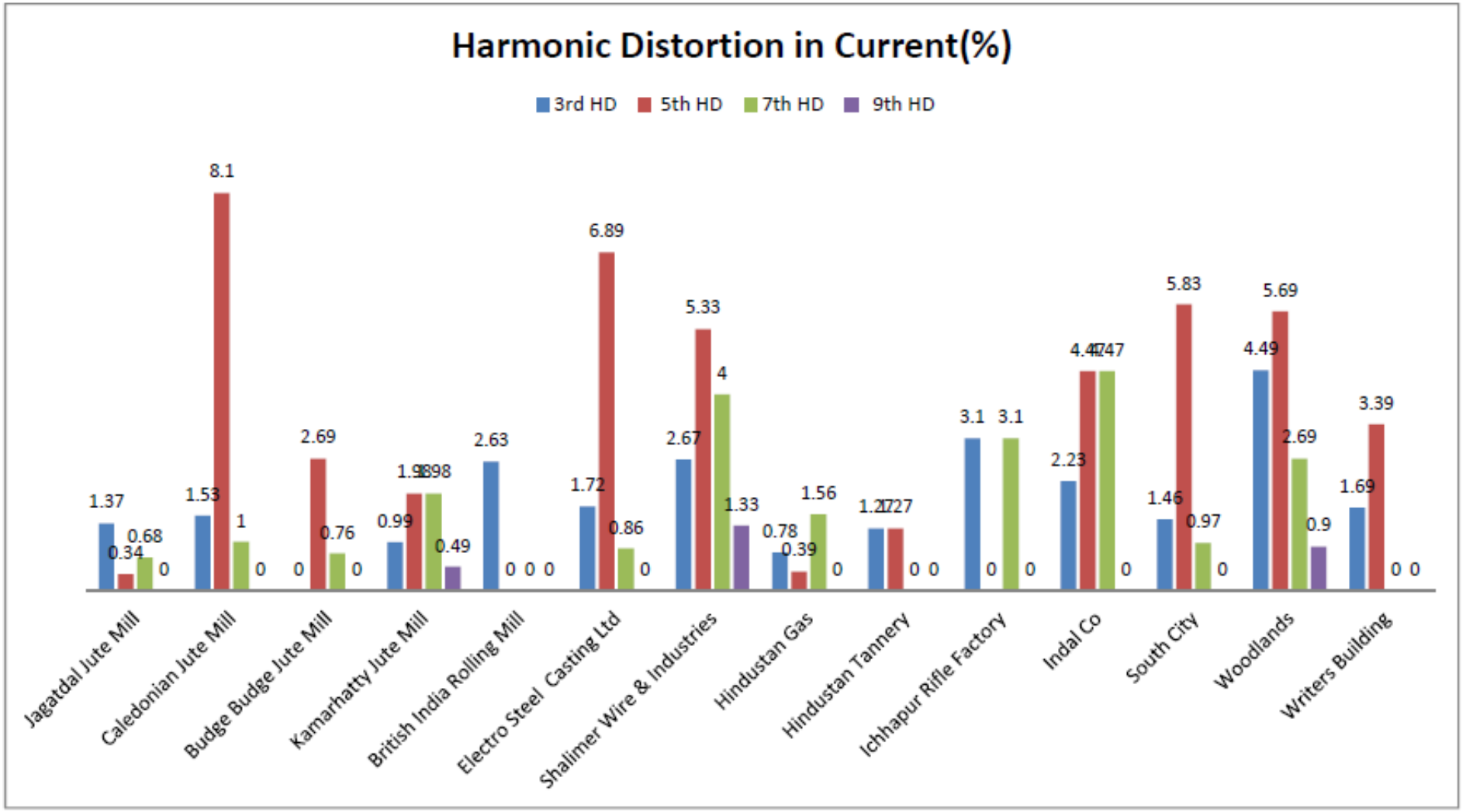

Power Quality – Concerns

- Energy Efficient devices are found to generate high levels of Harmonic pollution, if not regulated by Standards.
- Solar PV invertors can also be a source of harmonic pollution.
- Higher levels of harmonics in the Distribution System may result in
  - Higher losses
  - Higher equipment loading and failures
  - Incorrect Energy metering

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Power Quality – Monitoring

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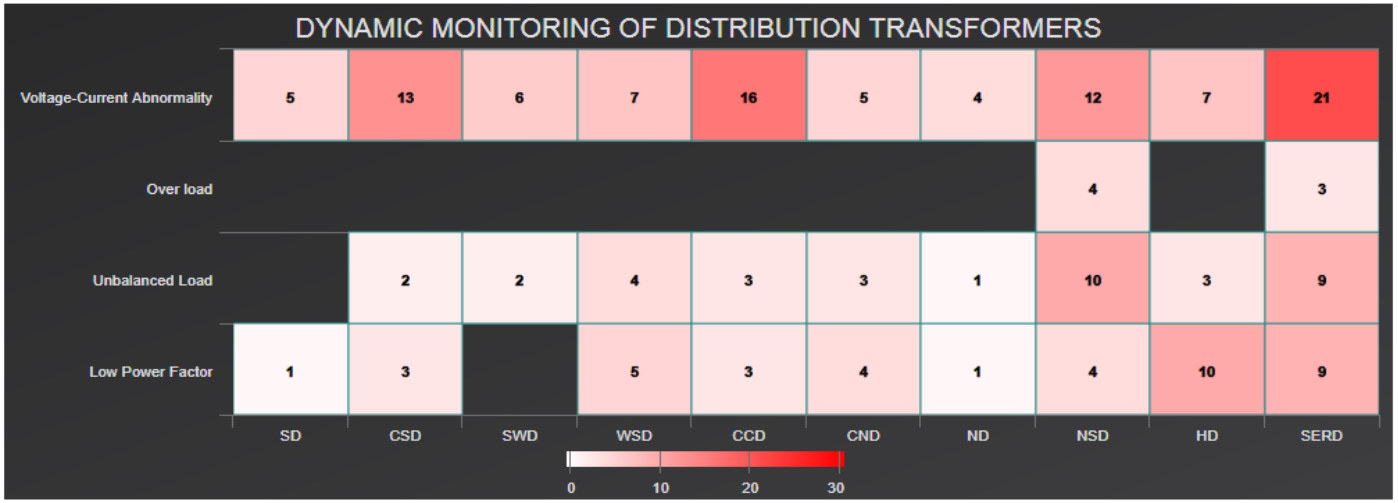

Last Reading Within	Load Exceeding	Unbalance Exceeding	With Loading >=	Avg PF <=	With Loading >=	Known Metering Defect	
1 Hr(s)	120 %	60 %	40 %	0.6	20 %	NO	SUBMIT

Based on Last Reading Available from DTRs

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DTR DYNAMIC DATA

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DYNAMIC MONITORING OF DISTRIBUTION TRANSFORMERS

SD : Voltage-Current Abnormality (Hit Submit button to back to Grid View)

Rows: 3

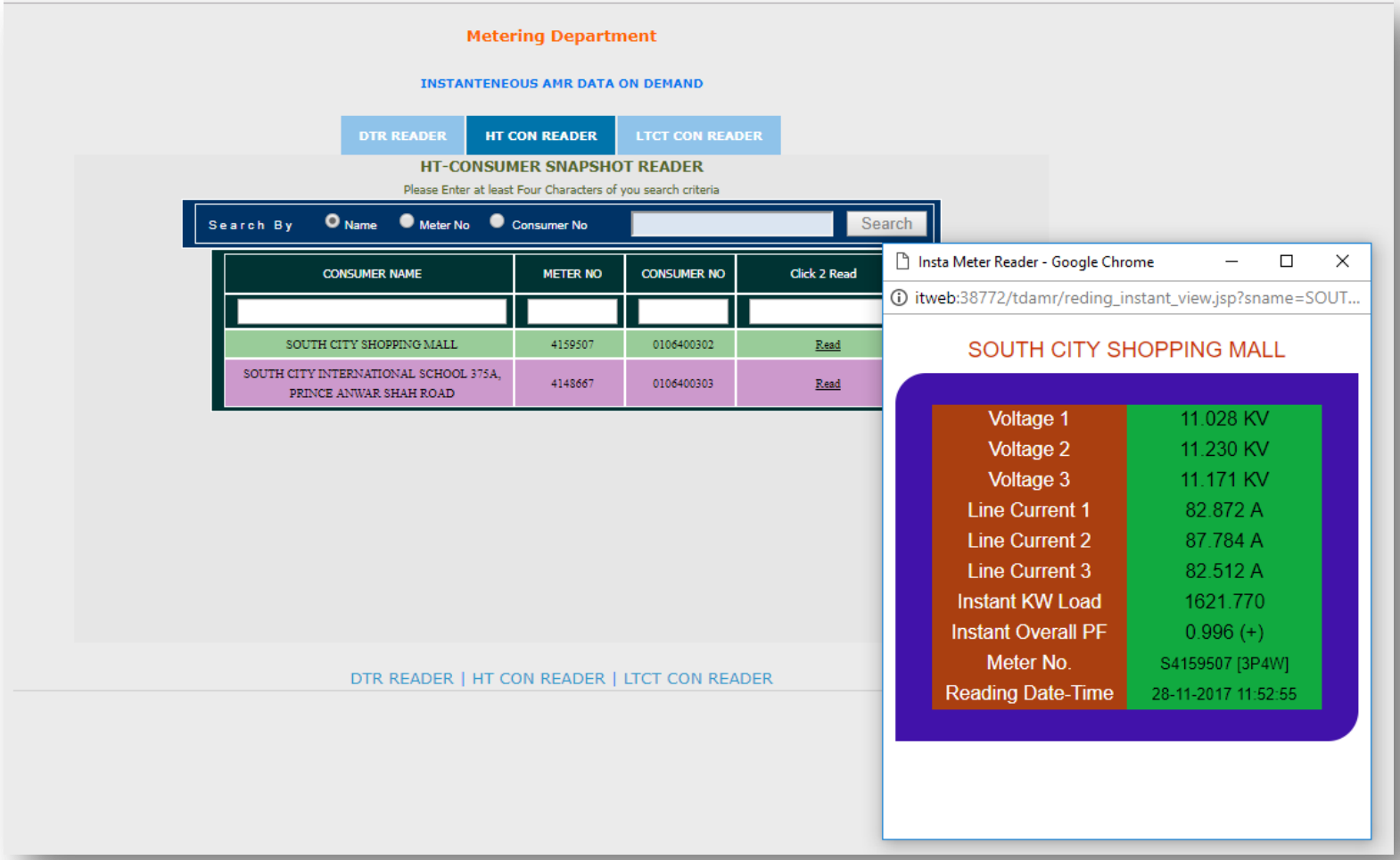
SOURCE NAME	SOURCE CODE	DIST	VR	VB	VY	LR	LB	LY	AVG PF	LAST READING DATE TIME	KVA RATING	ABNORMALITY	PROBABLE INFERENCE
GARIA SOUTH T/H	0104810	SD	6.813	242.13	240.52	95.4	153.3	147.5	.995	2017-11-28 11:15	315	Voltage-Current Abnormality	R-ph Voltage Missing Current Present (Met Defect ?)
BENI BANERJEE AVENUE O/T	0117200	SD	2.594	240.72	2.979	82	66.5	84	-.996	2017-11-28 11:03	315	Voltage-Current Abnormality	R-ph Voltage Missing Current Present (Met Defect ?) Y-ph Voltage Missing Current Present (Met Defect ?)
K.M.NASKAR RD O/T	0117100	SD	234.8	237.77	234.99	.1	.1	.1	.186	2017-11-28 11:03	315	Voltage-Current Abnormality	R-ph Current Missing (Feeder Fuse ?) Y-ph Current Missing (Feeder Fuse ?) B-ph Current Missing (Feeder Fuse ?)

Last Reading Within	Load Exceeding	Unbalance Exceeding	With Loading >=	Avg PF <=	With Loading >=	Known Metering Defect	
1 Hr(s)	120 %	60 %	40 %	0.6	20 %	NO	SUBMIT

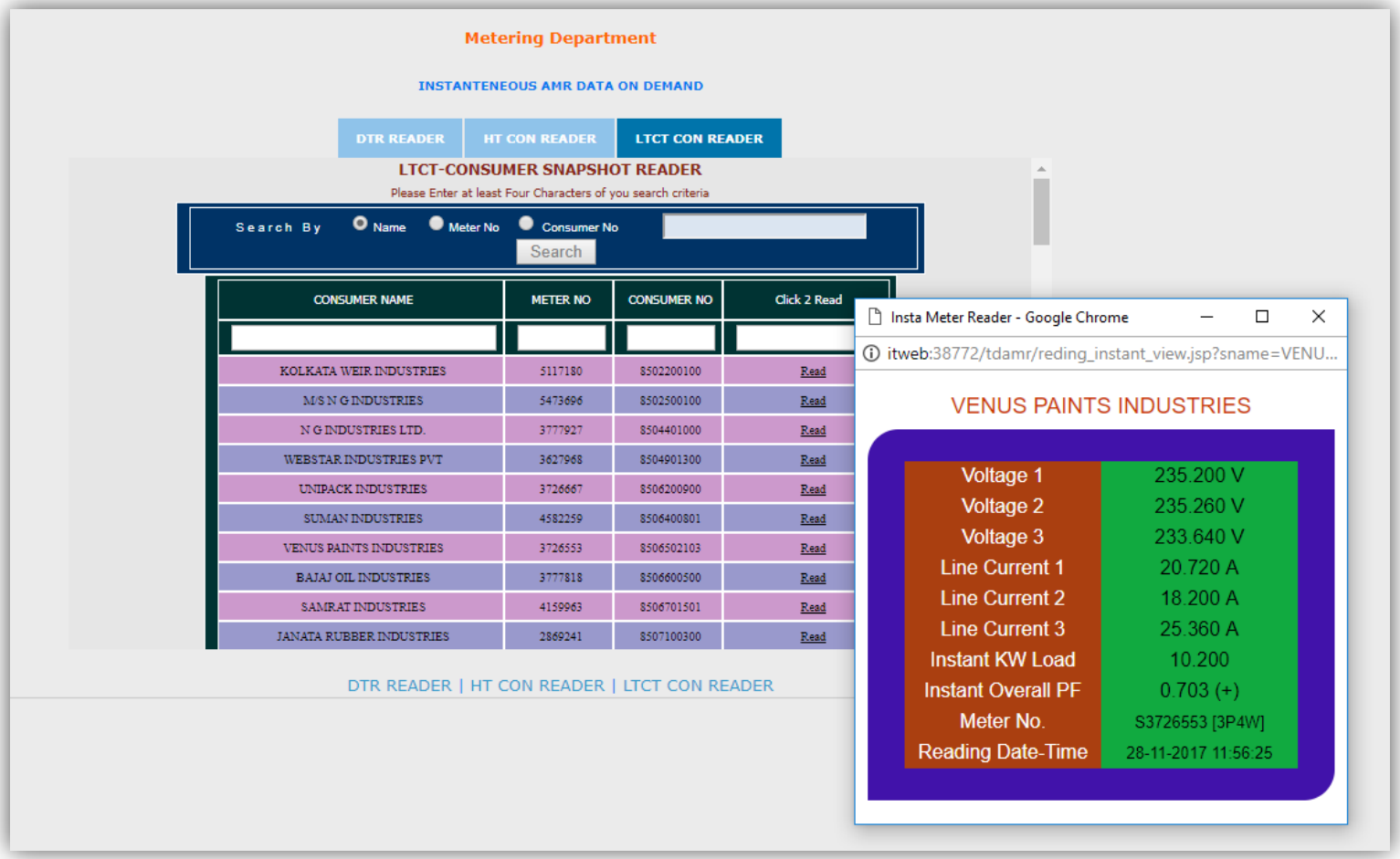
Based on Last Reading Available from DTRs

ENG US 11:44 28/11/2017

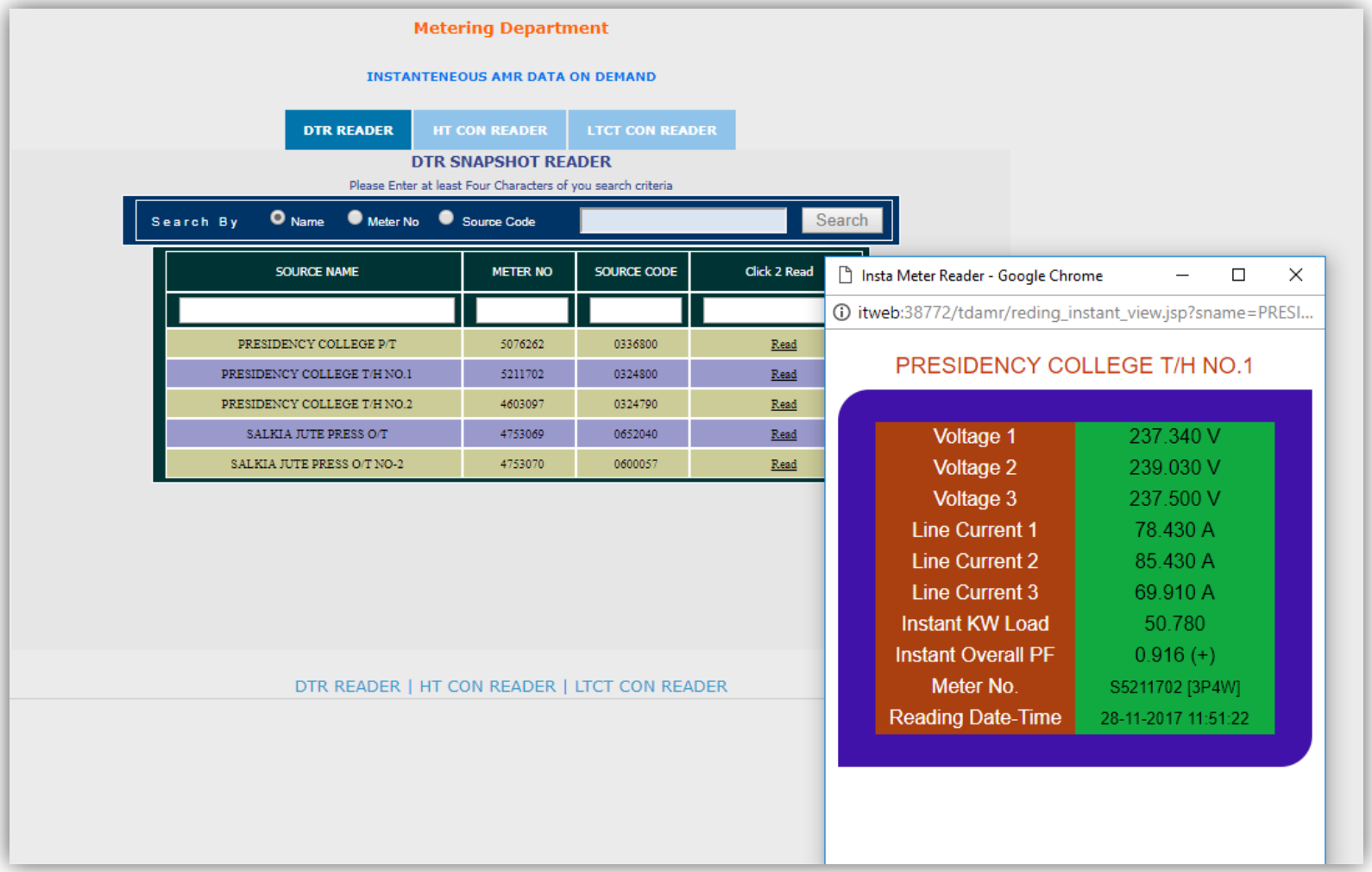
Instant Voltage Read - HT Consumer



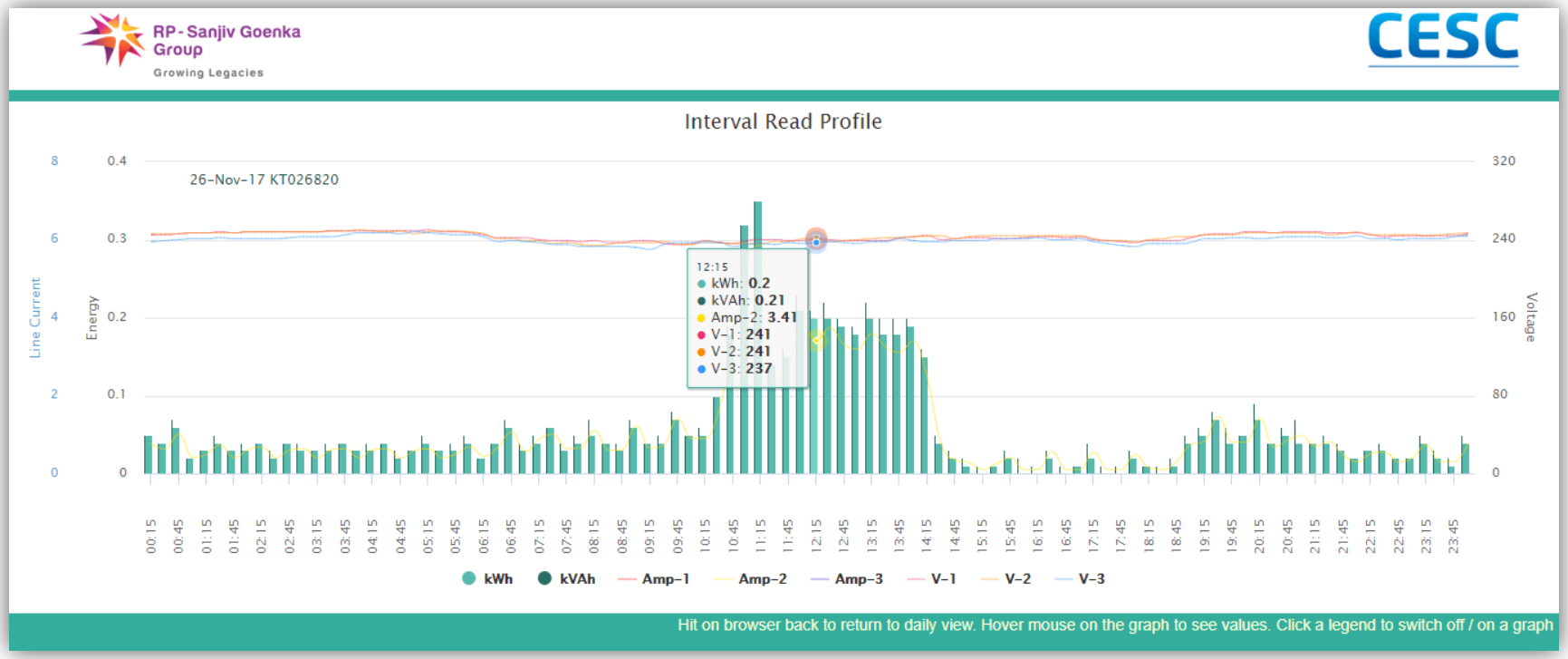
Instant Voltage Read - LT Consumer



Instant Voltage Read - DTR



Instant Voltage Read – LT Smart Meter



Thank You